Failure of four bovine pericardial mitral prostheses

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The bovine pericardial valve has a long history of excellent performance in both the aortic and mitral positions, with low rates of both short-term and long-term valve-related events.[1,2] In two large studies spanning 12 and 15 years, there were no reported occurrences of intraoperative structural failure.[1,2] Although there are some reports in the literature of early postoperative failure,[3] there are few reported cases of intraoperative failure of bovine pericardial valves.[4] We present 4 instances in 3 patients from two separate institutions of intraoperative structural failure of bovine pericardial mitral bioprostheses.

Clinical Summaries

PATIENT 1. An 81-year-old woman with coronary artery disease, New York Heart Association functional class 4 congestive heart failure, and severe mitral insufficiency underwent elective coronary artery bypass grafting and mitral valve replacement. Operative approach included sternotomy, bicaval cannulation, and open retrograde cardioplegia. After the completion of distal anastomoses, a left atriotomy was performed, revealing degenerated mitral valve leaflets with heavy mitral annular calcification. The anterior leaflet was resected, and pledgeted annular sutures were placed from the ventricular side. After placement, the 27-mm stented pericardial mitral prosthesis (model 6900; Edwards Lifesciences, Irvine, Calif) was noted to be centrally incompetent without evidence of leaflet trapping. The prosthetic valve was removed, the annulus was further débrided, and a second, larger pericardial prosthesis (29 mm) was placed.

After atrial closure, color Doppler transesophageal echocardiography (TEE) revealed severe central insufficiency of this second prosthesis (Figures 1 and 2). Cardioplegic arrest was repeated, and the pericardial prosthesis was removed and replaced with a 29-mm stented porcine xenograft (Mosaic; Medtronic, Inc, Minneapolis, Minn). The patient was weaned from cardiopulmonary bypass after a total of 314 minutes. Postbypass TEE revealed no evidence of prosthetic valve dysfunction. The patient had a complicated postoperative course, which included sternal wound infection and sepsis, and died 6 months after the operation.

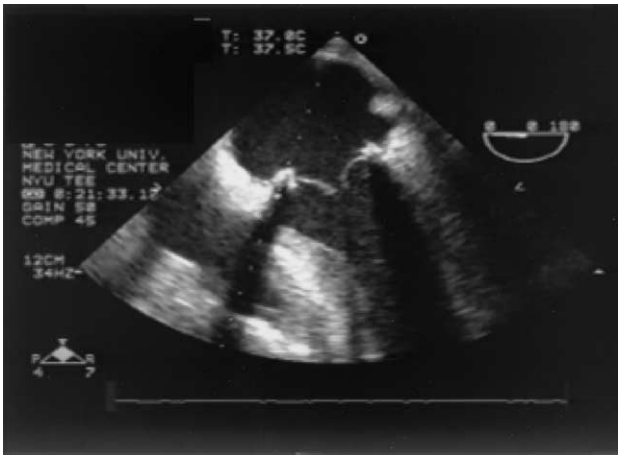

Figure 1. Intraoperative TEE frame demonstrating maximal leaflet closure after placement of second valve prosthesis.

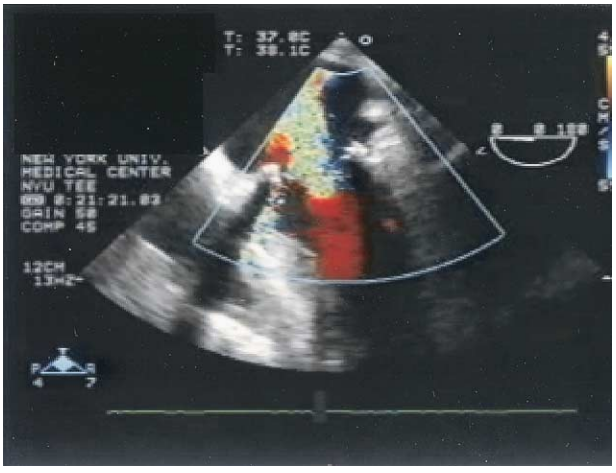

Figure 2. Intraoperative TEE frame with color Doppler after placement of second valve prosthesis. Massive central insufficiency is noted.

PATIENT 2. A 78-year-old woman with severe mitral regurgitation but preserved left ventricular function and normal coronary arteries underwent elective mitral valve repair. Operative approach included sternotomy, bicaval cannulation, and antegrade cardioplegia. Posterior quadrangular resection was performed, along with annular plication. Insufficiency was noted on completion, so the anterior leaflet was resected and the valve was replaced with a

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29-mm Carpentier-Edwards bovine pericardial prosthesis (model 6900; Edwards Lifesciences) with pledgeted sutures.

Hydraulic testing of the prosthetic valve revealed severe central regurgitation, so it was removed and replaced with a 29-mm Carpentier-Edwards porcine bioprosthesis (Edwards Lifesciences). There was no further insufficiency detected. The patient was weaned from bypass with a total crossclamp time of 1 hour and 55 minutes. Postoperative course was uneventful.

PATIENT 3. An 89-year-old woman with severe mitral and tricuspid regurgitation and preserved left ventricular ejection fraction underwent elective mitral valve replacement and tricuspid valve repair. Operative approach included sternotomy, bicaval cannulation, and antegrade cardioplegia. Inspection of the mitral valve revealed myxomatous degeneration with prolapse of the anterior and posterior leaflets. The mitral valve was resected and replaced with a 29-mm Carpentier-Edwards bovine pericardial prosthesis using pledgeted sutures (model 6900; Edwards Lifesciences). Visual inspection revealed mild central regurgitation. The left atrium was closed, the right atrium was opened, and the tricuspid valve was repaired with a 32-mm Carpentier-Edwards annuloplasty ring (Edwards Lifesciences). Postbypass TEE revealed severe central insufficiency of the prosthetic valve. Bypass was reinstituted, the mitral prosthesis was removed, and a 29-mm Carpentier-Edwards porcine bioprosthesis (Edwards Lifesciences) was inserted. Total aortic crossclamp time was 2 hours and 45 minutes.

The patient had a complicated postoperative course, including reoperation for bleeding, placement of an intra-aortic balloon pump for heart failure, neurologic dysfunction, sepsis, and ultimately multiorgan system failure. She died on post-operative day 26.

Discussion

Intraoperative valve prosthesis failure is an uncommon event that most surgeons will never see. Although very few cases have been reported in the literature, it can occur with both low-profile mechanical valves and stented tissue prostheses. Acute mechanical valve dysfunction can occur with leaflet motion obstruction either at the hinge mechanism or along the line of closure between the leaflet and valve housing. The source of obstruction may be residual para-annular tissue, papillary muscle, thrombus, exuberant knots, or excessively long suture tails.[4,5] Intracardiac catheters may also be a source of acute mechanical valve dysfunction. Additionally, disruption of the prosthesis can occur with loss of a leaflet. Ball-cage valves may fail as the result of entrapment of the ball by subvalvular tissue.

Acute stented tissue valve dysfunction may be caused by iatrogenic leaflet injury or misplacement at implantation. Leaflet and prosthesis distortion may be caused by technical problems at implantation, including strut entrapment by the subvalvular apparatus or suture loops. In both scenarios the leaflet edge may be trapped near the apex of the strut, restricting leaflet tissue motion.

We report here 4 instances of stented pericardial tissue valve failure in 3 patients. No evidence of strut entrapment was noted in any of the cases. Normal valve function was observed after the prostheses were replaced with stented porcine valves. We speculate that mitral annular disease may have distorted the normal planar geometry of the pericardial prosthesis, resulting in failure of adequate central leaflet coaptation. This was not observed with a similarly sized stented porcine prosthesis, implying that the depth of leaflet coaptation in native porcine valves is more forgiving of annular distortion. Although it is uncommon, surgeons should be aware of this failure modality of tissue prostheses.

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